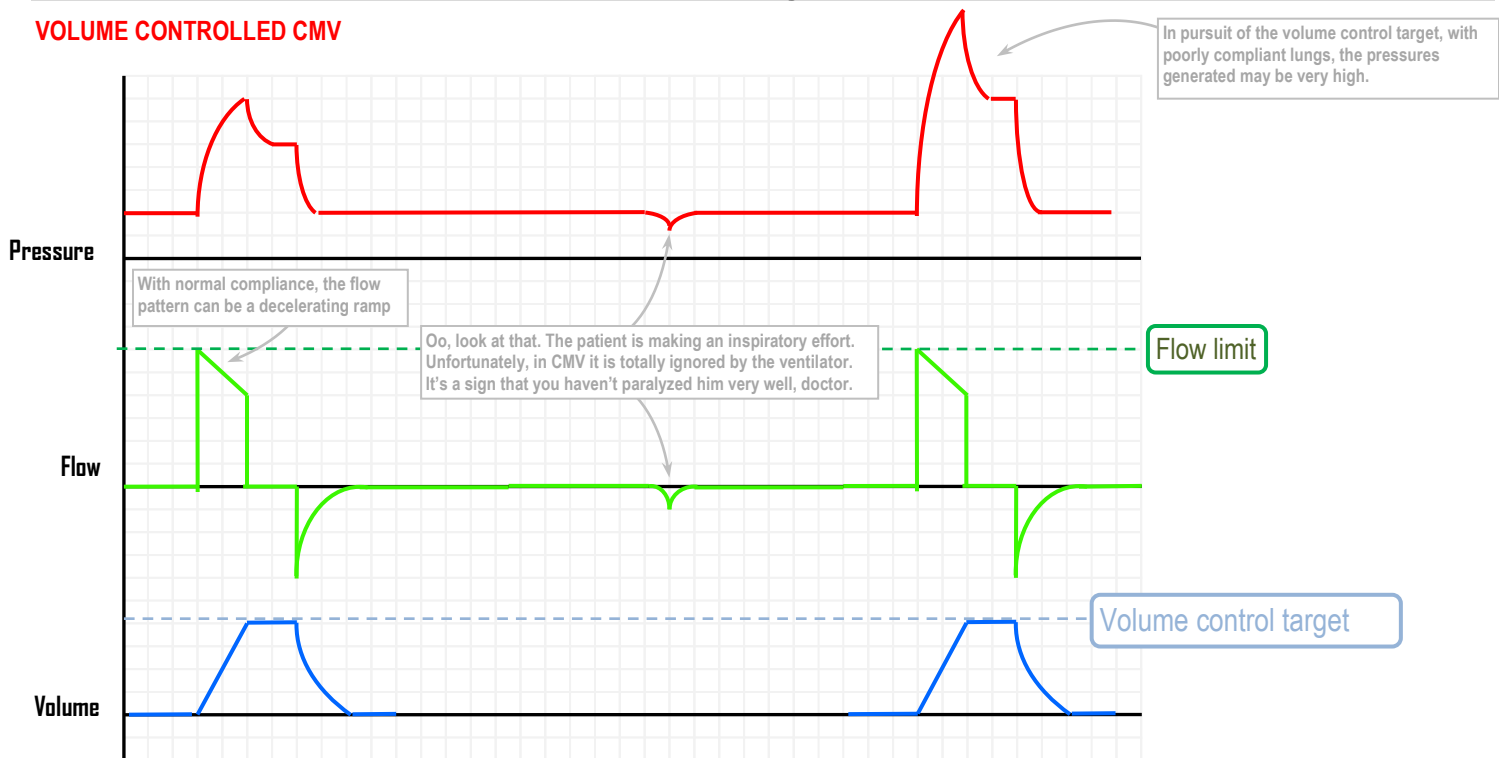


CMV: Continuous Mandatory Ventilation

VOLUME CONTROLLED CMV



- **Volume Controlled** ...but it can be pressure-controlled
- **Time-Triggered**
Volume-limited OR Pressure-limited, Flow-limited (but doesn't have to be flow-limited)
- **Time-Cycled** (but it can be volume-cycled if you don't want inspiratory pauses)

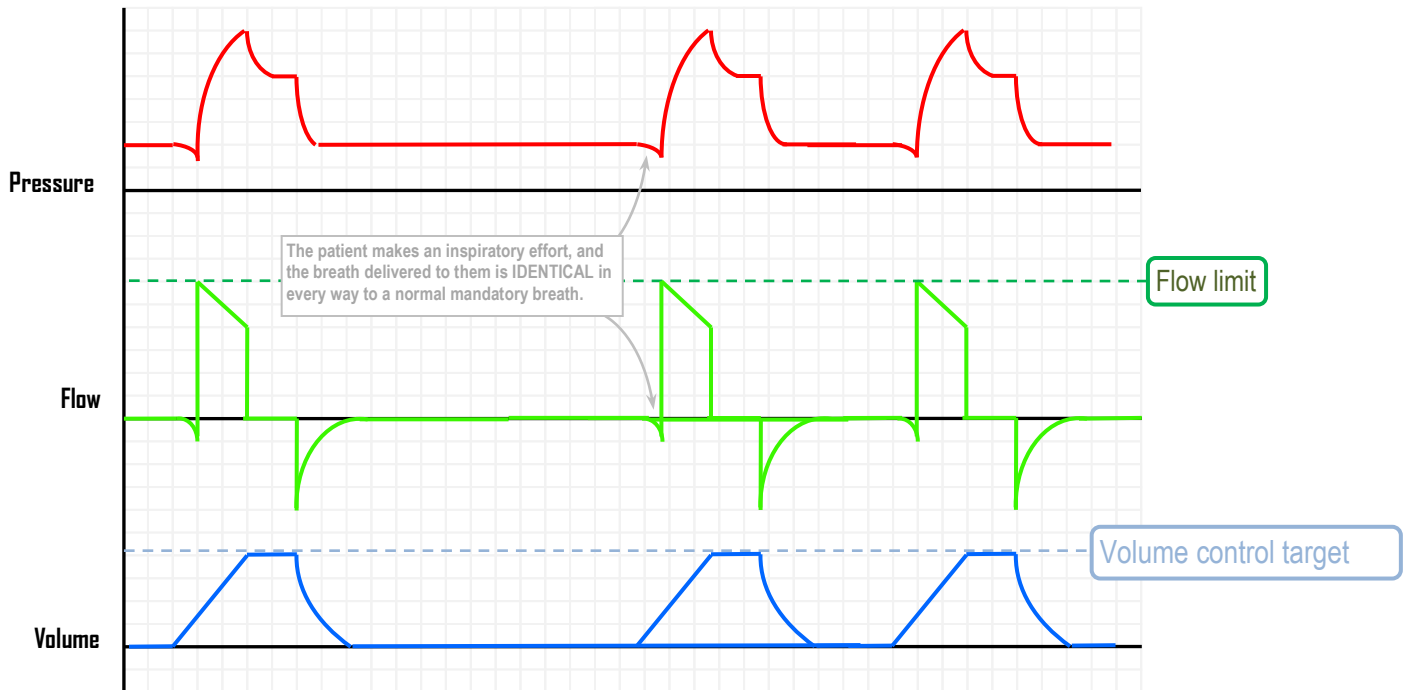
The key feature is, its MANDATORY, time triggered and time cycled, and it ignores attempts to breathe.

The volume-controlled CMV gives you optimal control over your minute volume. If you are trying to maintain a very narrow CO₂ range in a paralysed sedated head injury patient, this would be a good choice. Of course, if they wake up, they will start fighting the ventilator, coughing and sucking weirdly against it, as it obstinately blows unwanted breaths into their lungs.

It is an uncomfortable mode of ventilation for anyone who is even slightly awake.

ACV: Assist Control Ventilation

VOLUME CONTROLLED ACV



- **Volume Controlled** (but could be pressure controlled)
- **Flow-Triggered** (but could be anything-triggered)
..typically, there is a backup mode, which is time triggered. In case the patient forgets to breathe.
- **Volume- limited, Flow-limited** (but doesn't have to be flow-limited)
- **Time-Cycled** ((but it can be volume-cycled if you don't want inspiratory pauses)

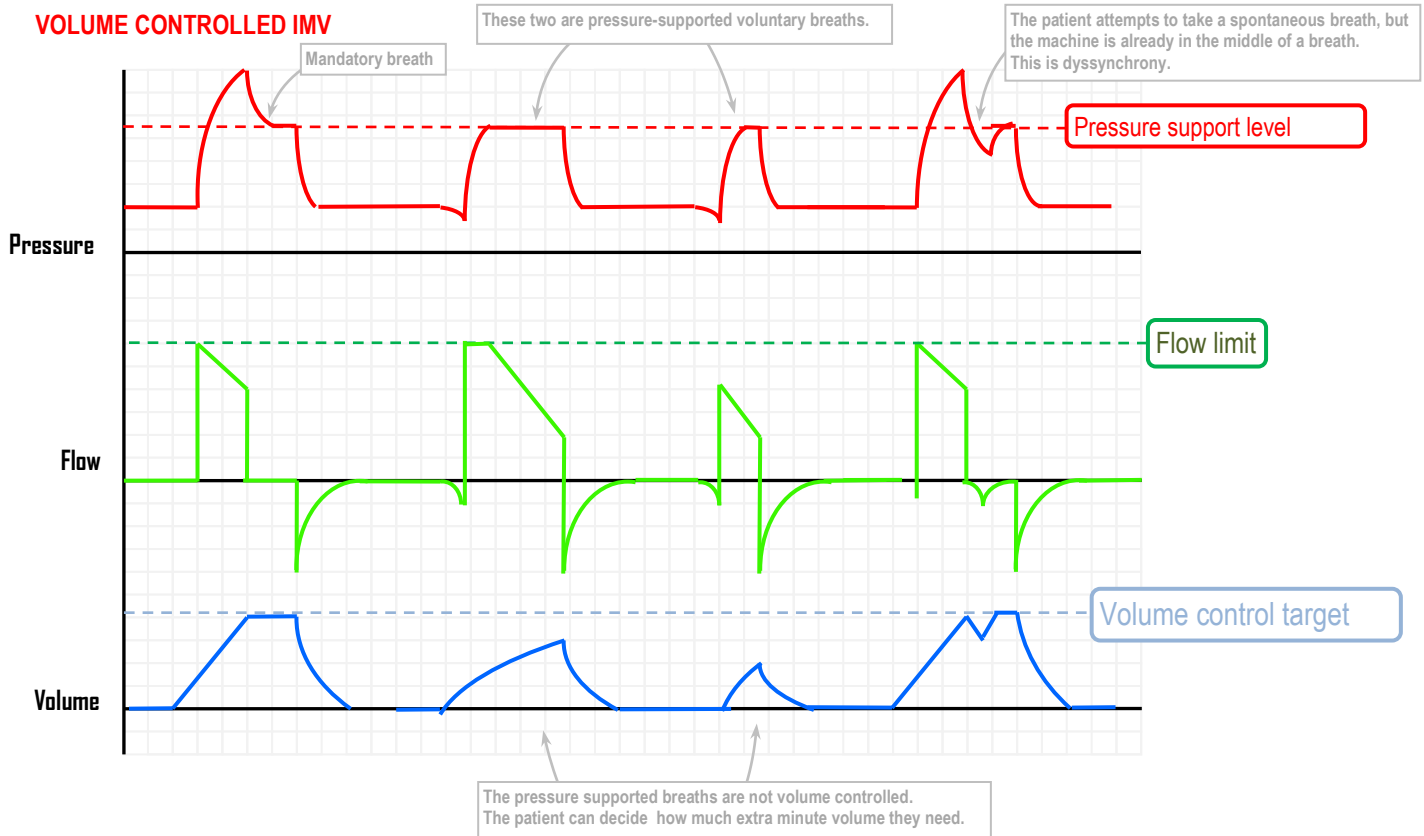
The key feature is, EACH BREATH IS THE SAME. The patient can decide on their own respiratory rate- but the tidal volume is controlled, and each breath is time-cycled or volume cycled.

The volume-controlled ACV gives you limited control over your minute volume. The patient may take as many breaths as he damn well please. With volume-controlled ACV you can control the tidal volume, at least. There is also Pressure-controlled ACV, which is discussed later, and for some reason called PCV (Pressure Controlled Ventilation).

This is slightly better for the partially sedated patient; however, it is still uncomfortable to have the same volume of air rigidly pushed into you.

IMV: Intermittent Mandatory Ventilation

VOLUME CONTROLLED IMV



- **Volume Controlled** ...but it can be pressure-controlled
- **Time-Triggered** – and the pressure support breaths are flow-triggered
- **Volume-limited OR Pressure-limited, Flow-limited** (but doesn't have to be flow-limited)
- **Time-Cycled** (but it can be volume-cycled if you don't want inspiratory pauses)

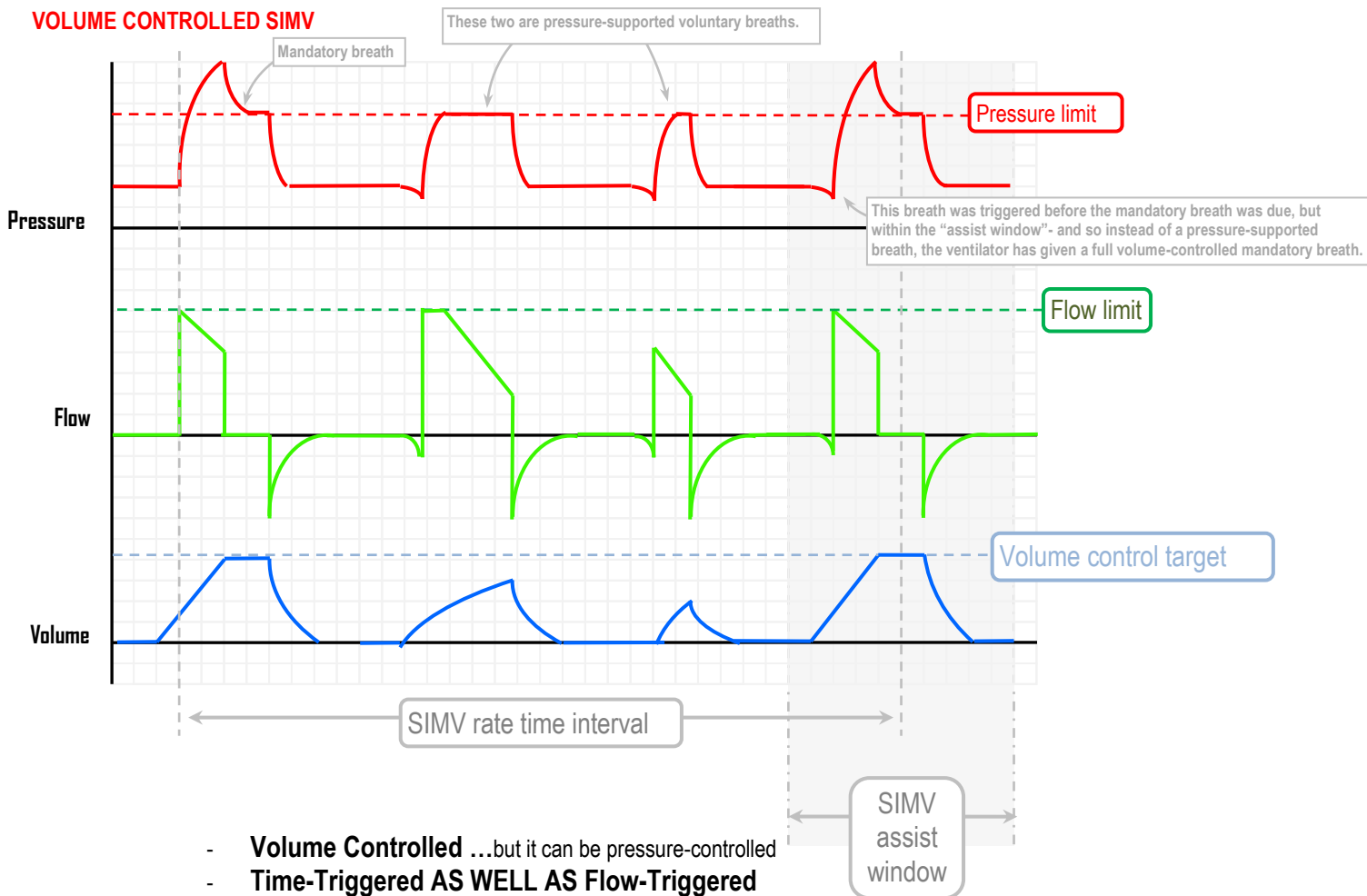
The key feature is, ITS NOT CONTINUOUSLY MANDATORY. The patient can decide on their own respiratory rate and they can take a number of pressure-supported breaths. However, among those, the machine also gives a set number of mandatory breaths, to supplement the patients own efforts.

You get little control over the minute volume. The patient may take as many pressure-supported breaths as he feels like, all you can do is guarantee a certain minute volume with volume-controlled IMV.

This is slightly better for the partially sedated patient; they get to try and breathe a little. The problem is, the machine has its own rate, and it doesn't care about what the patient wants. It just has a job to do; and if it has been programmed to deliver a volume-controlled time-cycled breath every 10 seconds, then its going to do just that, and if youre trying to breathe or cough or something- that's just too bad, youre getting your 500ml of gas.

SIMV –Synchronised Intermittent Mandatory Ventilation

VOLUME CONTROLLED SIMV



- **Volume Controlled** ...but it can be pressure-controlled
- **Time-Triggered AS WELL AS Flow-Triggered**
- **Volume-limited OR Pressure-limited, Flow-limited** (but doesn't have to be flow-limited)
- **Time-Cycled** (but it can be volume-cycled if you don't want inspiratory pauses)

The key feature is, ITS SYNCHRONISED.

The patient can decide on their own respiratory rate and they can take a number of pressure-supported breaths. However, among those, the machine also gives a set number of mandatory breaths.

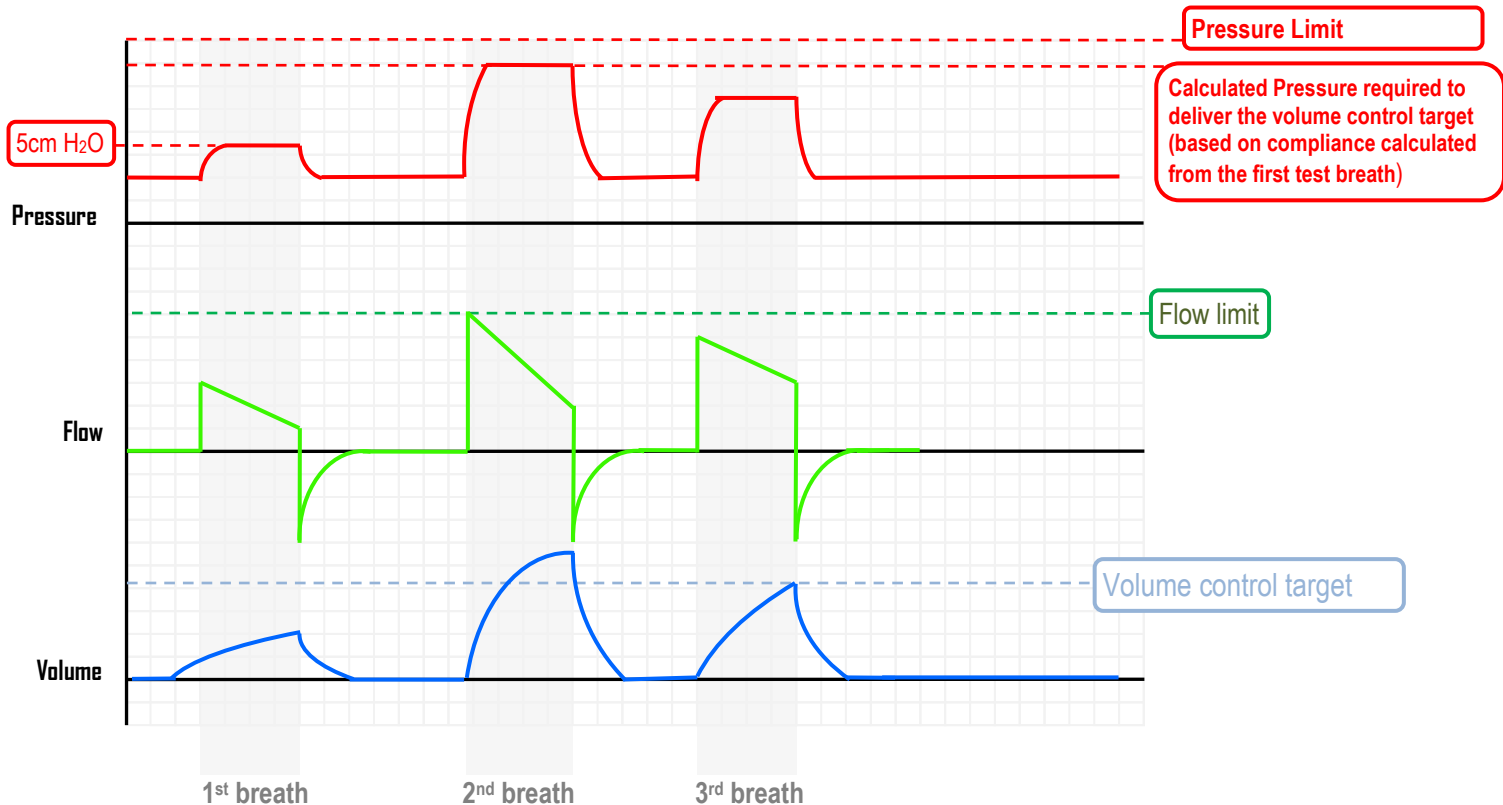
If the patient makes an effort around the same time the next mandatory breath is due, the ventilator delivers to them an assist-control breath, with volume control.

You get little control over the minute volume. The patient may take as many pressure-supported breaths as he feels like, all you can do is guarantee a certain minute volume with volume-controlled IMV.

A wide-awake patient would still find this mode relatively comfortable, because of the way it synchronises breaths.

SIMV With PRVC: Pressure-Regulated, Volume-Controlled

VOLUME CONTROLLED PRESSURE REGULATED SIMV- here demonstrated without spontaneous breaths



- Volume Controlled
- Time-Triggered – and the pressure support breaths are flow-triggered Pressure-limited, or rather “Pressure Regulated”
....Flow-limited (but doesn't have to be flow-limited)
- Time-Cycled AND Flow-Cycled

The key feature is, THE LOWEST POSSIBLE PRESSURE IS USED.

The first breath tests for compliance; it's a low-volume low-pressure calibration breath

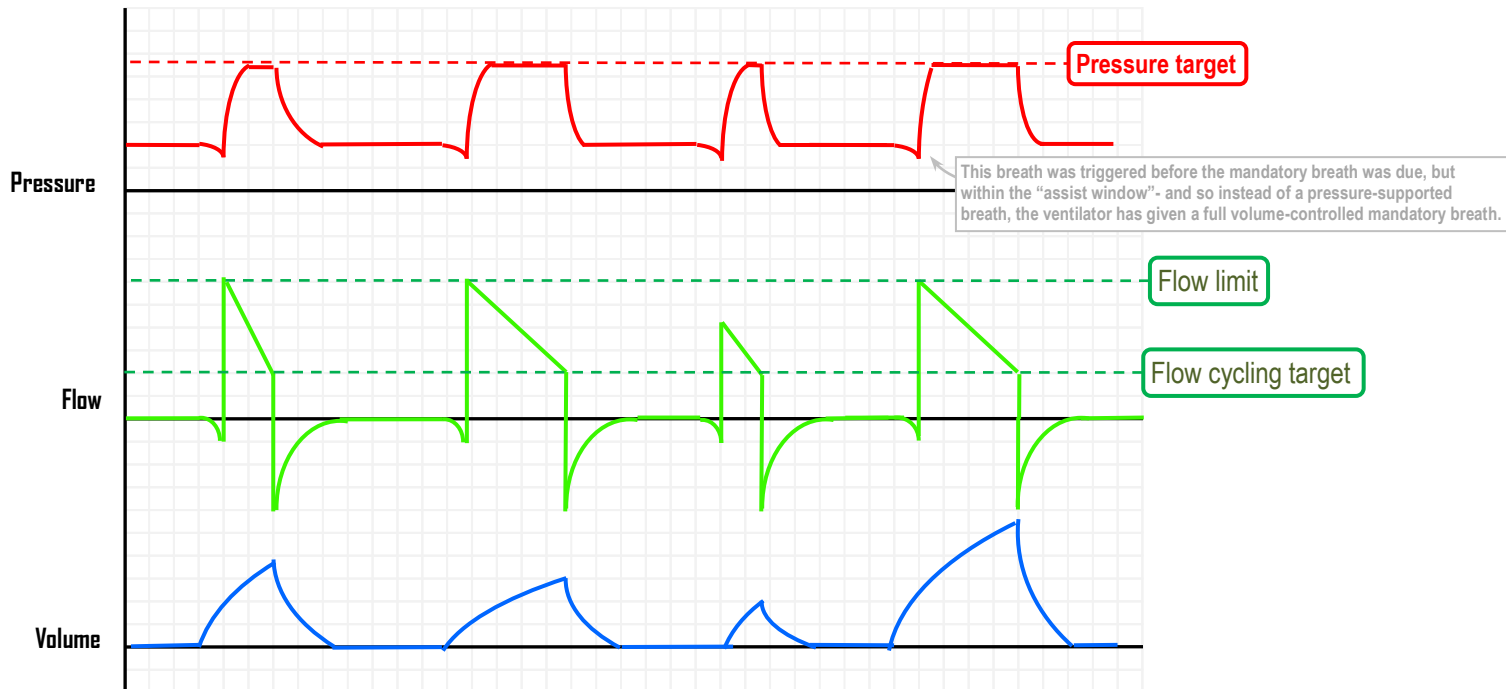
A compliance is calculated, and from this value, a pressure is calculated which would be required to deliver the controlled target volume.

The next breath is delivered at this calculated pressure. If the controlled target volume is exceeded, the ventilator adjusts the flow rate, so that with the next breath the pressure is slightly lower.

The subsequent breaths are delivered at the decreased pressure.

PSV: Pressure Support Ventilation

This is a form of pressure control ventilation, with a target pressure which is aimed for with each breath.



- Pressure Controlled
- Flow-Triggered – and the pressure support breaths are flow-triggered
- Volume-limited... but it doesn't have to be
-Flow-limited (but doesn't have to be flow-limited)
- Flow-Cycled

The key feature is, THE VENTILATOR ONLY CONTROLS THE PRESSURE SUPPORT LEVEL.

The rate, volume, cycling time and so forth are controlled by the patient.

You have some degree of control over the tidal volume: you can adjust the pressure support value (the higher it is, the higher a tidal volume the patient will inhale). You can also decrease the flow cycling trigger (so the breath lasts longer)

The flow has to be fast to reach the present pressure rapidly (just as in PCV)

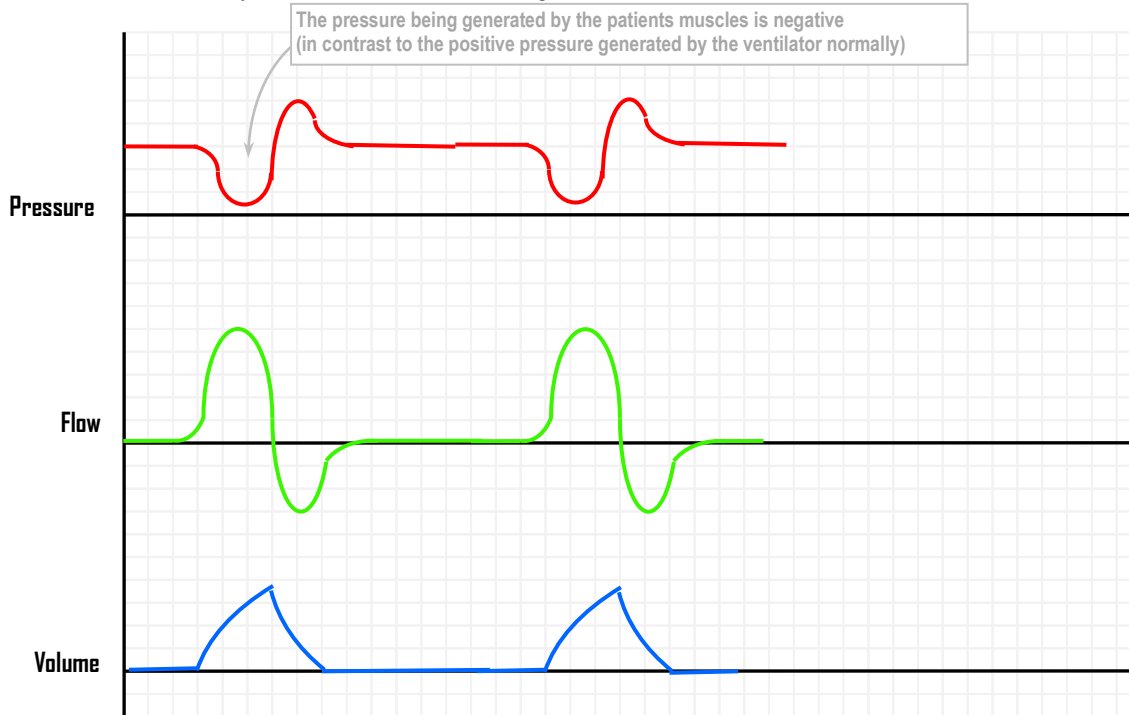
Thereafter, as the pressure is reached, the flow rate has to drop swiftly, or else the pressure will continue to rise

As soon as the flow drops to a set cycling target (usually, 25% of the flow limit), the ventilator cycles to expiration.

This mode is typically combined with SIMV, as the non-mandatory component.

CPAP: Continuous Positive Airway Pressure

This is a completely spontaneous breathing mode.



- **Not Controlled.**
- **Not Triggered**
Not Limited but it can be
Not Cycled

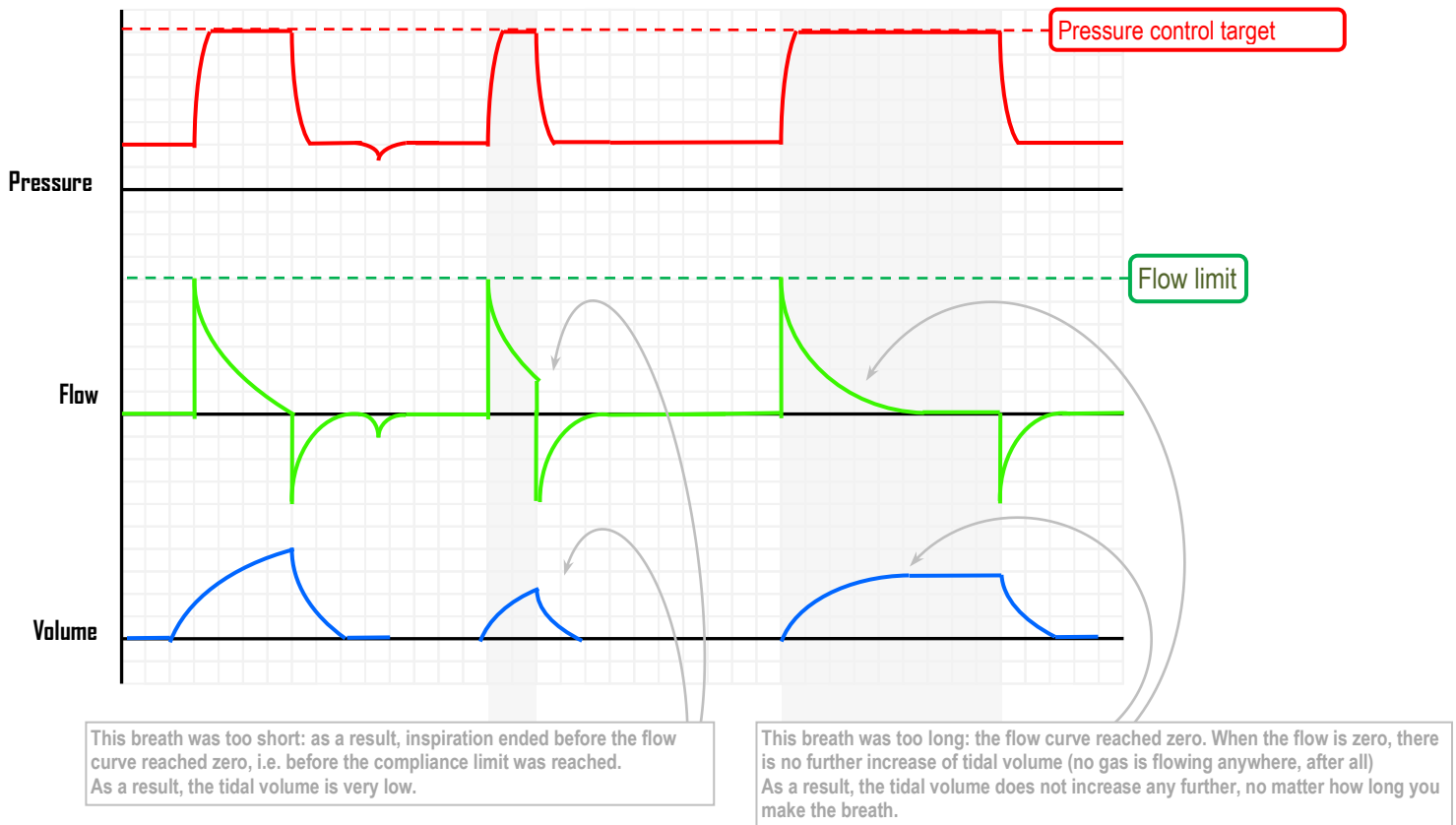
The key feature is, **NO SUPPORT**. There is some PEEP being delivered, but generally its up to the patient to fight the tubes of the circuit to suck air from the cold indifferent ventilator. With no help whatsoever. In fact, you can even turn the PEEP off.

!! CPAP is NOT PEEP. The two are not equivalent. CPAP is a spontaneous mode of ventilation, PEEP is the baseline setting of pressure and is really one of the phase variables.

PCV: Pressure-Control Ventilation

CMV, IMV, SIMV, ACV- all these modes can be pressure-controlled.

In this instance, the concept is demonstrated in the context of a CMV mode. But yes, you can set pressure as the control variable on any mode.



- **Pressure Controlled**
- **Time-Triggered** (but doesn't have to be)
- **Pressure-limited, Flow-limited** (but doesn't have to be flow-limited)
- **Time-Cycled**

The key feature is, THE PRESSURE IS YOUR PRIMARY GOAL.

This mode is typically used in patients with reduced lung compliance.

You tend to take what tidal volume you can get.

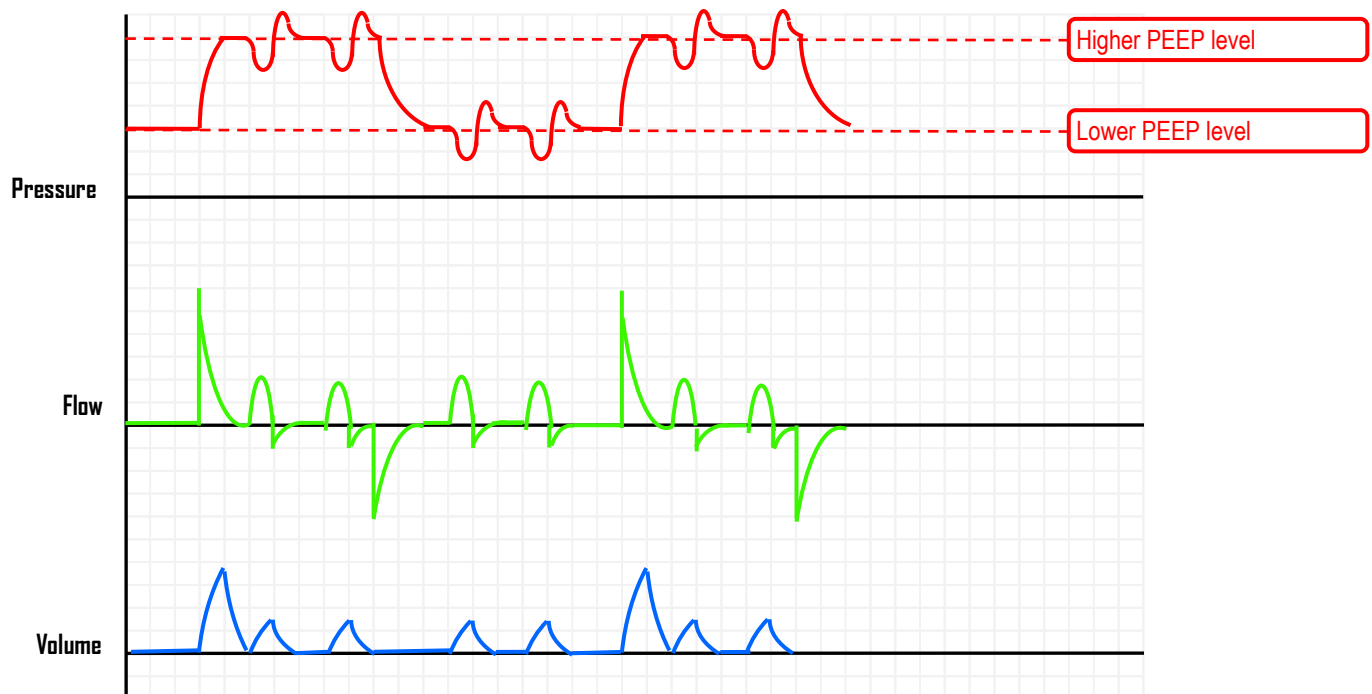
Typically, this mode is flow-triggered- the patient will become tachypneic if the tidal volume is inadequate, and this will compensate somewhat for the low tidal volumes you would expect in someone with very stiff lungs.

You get little control over the minute volume. The patient may take as many pressure-supported breaths as he feels like, all you can do is guarantee a certain minute volume with volume-controlled IMV.

A wide-awake patient would still find this mode relatively comfortable, because of the way it synchronizes breaths.

APRV: Airway Pressure Release Ventilation

Is basically CPAP with two different levels of PAP.



The key feature is, TWO LEVELS OF PEEP.

This mode can have pressure support added, or automatic tube compensation.

Expiration occurs during the low-PEEP time

The Low PEEP time (shown above to be equal to the high PEEP time) should NEVER be that long; it should be kept as low as possible to prevent de-recruitment.

The patient draws breath at two different lung volumes. At the high PEEP, the lungs are almost completely full, and the patient is breathing near vital capacity.

This mode of ventilation is usually reserved for severe ARDS. The next step would be HFOV.